

# **EXHIBIT 5**



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/944,808	07/17/2013	Steven R.J. Brueck	0023.0137	5016

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 MH2 TECHNOLOGY LAW GROUP, LLP  
 TIMOTHY M. HSIEH  
 1951 KIDWELL DRIVE  
 SUITE 550  
 TYSONS CORNER, VA 22182

EXAMINER
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BRADFORD, PETER

ART UNIT	PAPER NUMBER
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2897

NOTIFICATION DATE	DELIVERY MODE
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11/03/2014

ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

doreen@mh2law.com  
 kris@mh2law.com  
 docketing@mh2law.com

**Office Action Summary****Application No.**  
13/944,808**Applicant(s)**  
BRUECK ET AL.**Examiner**  
PETER BRADFORD**Art Unit**  
2897**AIA (First Inventor to File)  
Status**  
No**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --****Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10/6/14.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims\***

- 5) ☒ Claim(s) 1-24 is/are pending in the application.  
5a) Of the above claim(s) 5-13 and 22-24 is/are withdrawn from consideration.
- 6) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 7) ☒ Claim(s) 1-4 and 14-17 and 21 is/are rejected.
- 8) ☒ Claim(s) 4 and 18-20 is/are objected to.
- 9) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

\* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

**Application Papers**

- 10) ☒ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

- a) ☐ All b) ☐ Some\*\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)  
Paper No(s)/Mail Date 7/17/13, 10/9/13
- 3) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 4) ☐ Other: \_\_\_\_\_.

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### **DETAILED ACTION**

1. The present application is being examined under the pre-AIA first to invent provisions.

#### ***Specification***

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed. The examiner proposes: TRANSISTOR WITH A HETEROEPITAXIAL LAYER FORMED ON PEDESTALS

#### ***Claim Objections***

3. Claim 4 recites “The method of claim 1, wherein and the seed area comprises . . . .” The “and” here is spurious.

#### ***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent

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granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-3, 14, 16, and 21 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Homyk, US 2011/0140085. Homyk is also available as prior art under pre-AIA 35 U.S.C. 102(a) and 102(e).

6. Claim 1: Homyk discloses

- a. providing a semiconductor substrate (310);
- b. forming a seed area (350) delineated with a selective growth mask (350) on the semiconductor substrate, the seed area comprising a first material and having a linear surface dimension of less than 100 nm;
  - i. “Lithography and highly anisotropic etching enables routine fabrication of 30-50 nm nanostructures (100) in silicon with over 40:1 aspect ratios as shown in FIG. 1. Such structures can be further reduced in diameter by a subsequent thermal oxidation, wherein the oxidation process can be designed to self-terminate such that nanoscale pillars below 10 nm in width can be defined, allowing wide processing latitude.” Homyk at [0027].
- c. and growing a heteroepitaxial layer (374, [0036]) on the seed area, the heteroepitaxial layer comprising a second material that is different from

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the first material. (“The steps described from FIGS. 3A-3E describe methods of fabricating heterostructures on a substrate where the heterostructures are self-aligned.” [0039].)

7. Claim 2: the linear surface dimension is less than 25nm. Homyk at [0027].
8. Claim 3: the seed area is raised from the semiconductor substrate surface to form a pedestal (Homyk FIG. 3C).
9. Claim 14: Homyk discloses
  - d. providing a semiconductor substrate (310);
  - e. forming a nanostructured pedestal (350) on the semiconductor substrate, the pedestal having a top surface and a side surface, the top surface forming a seed area having a linear surface dimension that ranges from about 10 nm to about 100nm (Homyk at [0027]);
  - f. providing a selective growth mask layer (330) on the top surface and side surface of the pedestal (Homyk FIG. 3B);
  - g. removing a portion of the selective growth mask layer to expose the seed area of the pedestal (FIG. 3C);
  - h. and growing a heteroepitaxial layer (374) on the seed area.
10. Claim 16: Homyk discloses providing the selective growth mask comprises oxidizing a surface of the pedestal. See Homyk at [0032]: “the nanopillar (320) [is] covered by an insulator, which can be an oxide layer (330), e.g., silicon

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dioxide (SiO<sub>2</sub>) or other dielectric. The oxidation process can expand the silicon lattice by approximately 40% to incorporate oxygen.”

11. Claim 21: the heteroepitaxial layer comprises a Group III-V semiconductor material.

***Claim Rejections - 35 USC § 103***

12. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 4, 15, and 17 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Homyk in view of Lagally, US 2011/0100411. Homyk discloses a silicon substrate, but does not disclose what the crystal orientation of the substrate is. However, (001) was the most common substrate used in the semiconductor arts, including in the manufacturing of nanowire devices. See Lagally at [0022]: “where the nanowires and nanoribbons are formed from a silicon substrate, silicon starting materials and processing techniques which are widely used and readily available may be employed. For example, the substrate from which the nanowires and nanoribbons are fabricated (e.g., silicon-on-insulator; see discussion below) may be obtained with silicon template layers in all

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of the low-index crystallographic orientations, with (001) the most common and (110) and (111) for certain advanced electronic applications.” Thus it was known in the art to form nanowires from a (001) silicon substrate, and in fact this was the most common orientation in silicon devices. Thus those in the art would have expected a (001) orientation in the substrate of Homyk as the default crystal orientation, absent some reason to use a different orientation.

14. Claim 4: the seed area comprises a (001) plane of single crystal Si and the heteroepitaxial layer comprises a material chosen from a Group I-V semiconductor material or germanium ( $\overline{[0036]}$ ). As the seed area is a horizontal surface (at the top of the nanowire), the surface will be a (001) plane.

15. Claim 17: removing the portion of the selective growth mask layer to expose the seed area comprises etching the insulator to expose a (001) plane of the silicon material. As the seed area is a horizontal surface (at the top of the nanowire), the surface will be a (001) plane.

***Allowable Subject Matter***

16. Claims 18-20 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art reviewed by the examiner does not disclose forming a nanostructured pedestal on a semiconductor substrate, the pedestal having a top surface and a side surface, the



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top surface forming a seed area having a linear surface dimension that ranges from about 10 nm to about 100nm, providing a selective growth mask layer on the top surface and side surface of the pedestal; removing a portion of the selective growth mask layer to expose the seed area of the pedestal; selectively etching back the exposed top surface of the pedestal; and growing a heteroepitaxial layer on the seed area.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PETER BRADFORD whose telephone number is (571)270-1596. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Fernando Toledo can be reached on (571) 272-1867. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/PETER BRADFORD/  
Examiner, Art Unit 2897